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Control System Design for Planar LSM Drive

Engineering Design

Introduction

A number of technological equipmet movement systems is build on the basis of linear stepper motors (LSM). This class of drives have very high dynamical and precision characteristics; movement system functionality, veloctiy and precision are determined by control system of drives.

Control system

A number of controllers can be the basis for control system of LSM, though the main are PI, PD and PID controllers. The main problem in fine-tuning a controller is in determining the coefficients, the procedure of calculation is sophisticated, time-consuming and the results of calculation are usually not precise. The procedure of fine-tuning the controller described is to calculate the coefficients in real-time basing of the feedback sensors signals which are used both to form the feedback and to identify LSM model. Such approach helps in controller configuration and can be fulfilled in real-time using MATLAB Real-Time Workshop software.

The planar LSM drive control system is implemented on the basis of QLC-Drive controller which is produced by Ruchservomotor enterprise (Belarus). It is possible to set up travel parameters of LSM drives, control velocity and acceleration of the drives; QLC-Drive controller has an internal memory where parameters of control system are stored in real time. The controller is connected to a PC by RS-232 interface which is used to send commands and receive data back. After a command has been sent, a controller takes over the control of travel process.

The data stored in controller buffer are transferred to a PC via RS-232 interface. The program interface DSP-Host installed on a local PC, helps in processing received data and in solving the problem of program movement building. The control system is implemented on the basis of MATLAB software set and enables automatic controller programming, visualization of data, block diagram development, implements algorithms for numerical solution of differential equations, numerical integration, etc.

Model adequacy

To verify the worked out control system model, Identification Toolbox of MATLAB was used. This tool helps verify mathematical model with high accuracy. During experiments, the model of motor LSM-211PF.HS was verified. Identification Toolbox needs some input and output data which represent control signals and system response (fig. 1).

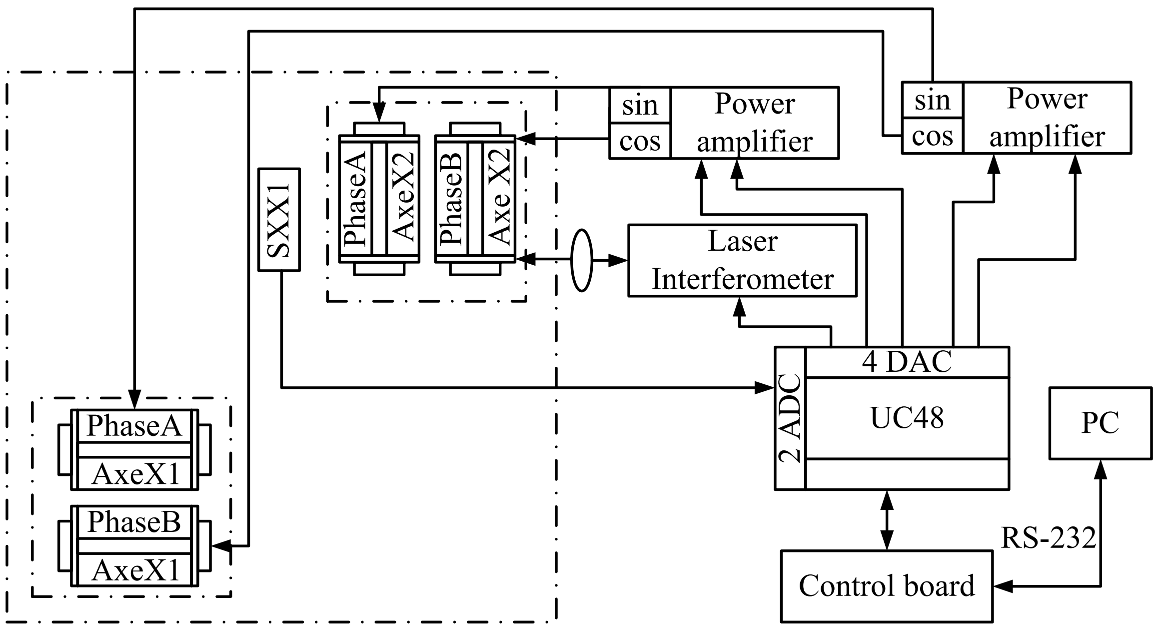

Fig. 1 Investigation Test Bench for Data Acquisition

Basing on these data, the transfer function of the system is built, and, using one of identification techniques, the model transfer function is constructed. For the case of PF-211.HS motor verification a hall-effect sensor was used, as this is a standard option of this class of drives. The computer model verification carried out showed that computational model adequacy is approximately 92…95% using different calculation methods.

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